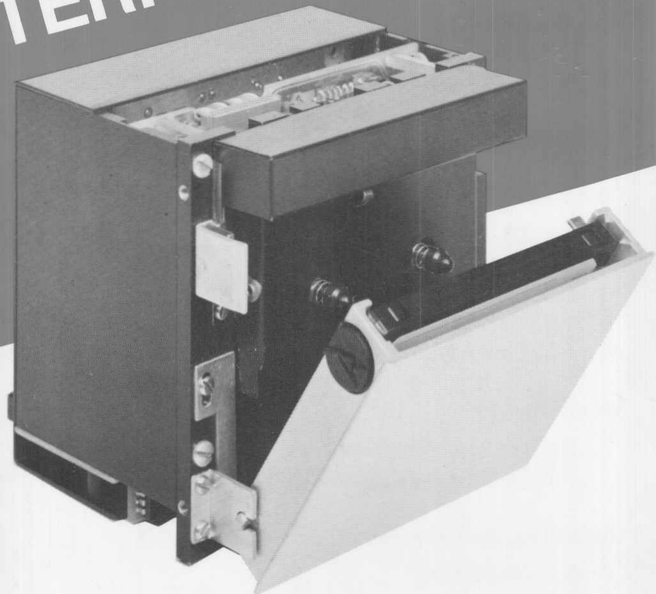
INSTRUCTION AND INTERFACE MANUAL



for

BRAEMAR

MODEL CS-400A

DIGITAL CASSETTE TAPE TRANSPORT SYSTEM

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Specifications in this document are subject to change without notice.

1. INTRODUCTION

This manual provides information to install and operate the Model CS-400A Digital Cassette Tape Transport System. The Model CS-400A (hereafter referred to as the "Transport System") is an input/output device using a certified grade digital cassette as a storage media.

All information is presented with the technician in mind. For this reason, it is assumed that the reader has a fundamental understanding of TTL and CMOS circuits and the basic principles of a cassette tape transport system.

2. GENERAL DESCRIPTION

The transport system is an electro-mechanical device for data storage/ retrieval used with certified digital cassettes employing 0.150-inch (0.381-cm) wide tape. The heavy duty construction, coupled with simplicity of design, makes the unit ideally suited to the rigorous demands of the data processing industry.

3. FEATURES SUMMARY

Engineered with the designer in mind, the unit provides the following features:

- Standard Unit uses 300-foot (91.4-meter) length tape.
- High reliability gained from simple, DC motor drive, only.
- Ingenious, push-to-open, push-to-shut "POPS" latch eliminates cumbersome and difficult "Release" provisions in the host equipment.
- Small, compact, and quiet.
- Rugged machined extrusions thoroughly enclose cassette.
- Constant, bi-directonal, tape forces provided by patented motion controller, insure maximum tape life.
- Short inter-record gap (IRG) controlled by host electronics.
- Only one supply voltage required, from 14 to 30 VDC.
- Low power consumption; only 6 watts nominal at 15 VDC supply.
- Two channels available for data.
- Total interface is TTL compatible.
- Read/Write electronics.
- Encoder/decoder converts TTL, serial, NRZ (non-return to zero) data to head levels and vice versa.
- One 44 pin board connector provides the entire interface, including test points to facilitate checkout.

- Operate in any position, from vertical to horizontal.
- Easy, behind-panel mounting.
- Various options include: cassette side sensor, cassette release interlock, remote-control cassette release, custom mounting, provisions for various length tapes, various read/write speeds, 115 VAC primary power, tape viewing window, and a fixed stop to control cassette insertion.

4. FUNCTIONAL DESCRIPTION

The transport system consists of several functional components as shown in Figure 1. Note that the unit has two major sub-assemblies: 1) the basic (Model CD-200) electro-mechanical transport mechanism (including motion controller board) and 2) the electronic package.

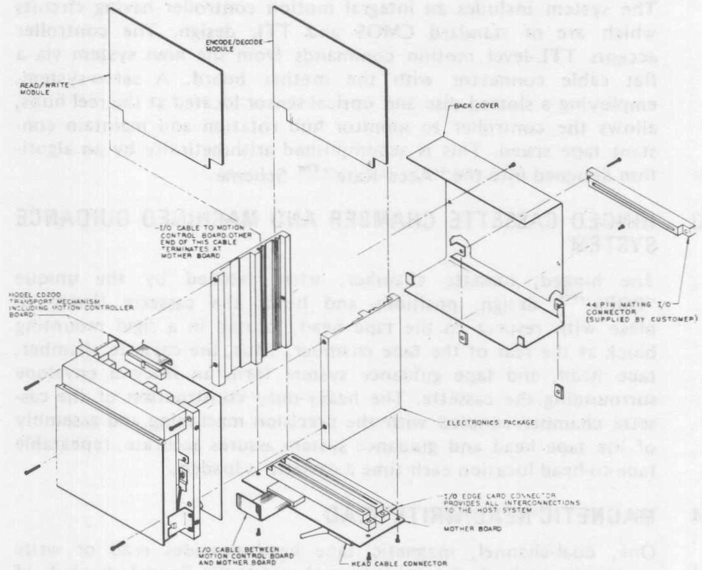


Figure 1. Transport System Functional Components

Following paragraphs describe the functional components.

4.1 DC MOTORS

The unit employs two DC motors, one at each hub of the cassette, to control the tape motion. Together, the two motors provide smooth, bi-directional tape control with a constant gentle tension eliminating tape billowing or harsh take-up shocks. The two DC motors comprise the entire mechanical drive motion of the transport. Slow Fwd/Rev (Read/Write) speed, Fast Fwd/Rev (search) speed. In addition, the motors have a stop/go mode which provides positive and accurate motion control in any of the four tape transporting modes. The standard read/write tape speed is 10 inches-per-second (IPS). Other Read/Write speeds are special options available from the factory. The search/rewind speed (fast) is 75 IPS, nominal.

4.2 MOTION CONTROLLER

The system includes an integral motion controller having circuits which are of standard CMOS and TTL design. The controller accepts TTL-level motion commands from the host system via a flat cable connector with the mother board. A servo-system, employing a slotted disc and optical sensor located at the reel hubs, allows the controller to monitor hub rotation and maintain constant tape speed. This is accomplished arithmetically by an algorithm designed into the "Accu-Rate"™ Scheme.

4.3 HINGED CASSETTE CHAMBER AND MACHINED GUIDANCE SYSTEM

The hinged, cassette chamber, when latched by the unique "POPS"™ design, positions and holds the cassette firmly in place with respect to the tape head, located in a rigid mounting block at the rear of the tape chamber. Thus, the cassette chamber, tape head, and tape guidance system form an integral envelope surrounding the cassette. The heavy-duty construction of the cassette chamber coupled with the precision machining and assembly of the tape head and guidance system assures accurate, repeatable tape-to-head location each time a cassette is loaded.

4.4 MAGNETIC READ/WRITE HEAD

One, dual-channel, magnetic tape head provides read or write capability on both the upper(outer) and lower (inner) channels of the head. The maximum bit density is 800 Bits per Inch (BPI). This is equal to 1600 Flux Changes per Inch (FCI) using the phase-

encoded format provided in this system. Included in the head assembly is a light-dark sensing photo-transistor for identifying clear-leader which is found at the end-of-tape (EOT) or beginning-of-tape (BOT). This sensor will also recognize pierced holes in tape, at all speeds if the user elects to employ this design.

4.5 ELECTRONICS PACKAGE

Two printed circuit boards containing logic circuits provide read/write and encode/decode interface electronics between the basic transport and the host system. Each of these boards has a solder-path edge-connector which plugs to a mating connector on what is termed a "mother board". The mother board combines all electronic circuits in the system and provides the complete electronic I/O to the host system.

5. SPECIFICATIONS

The following paragraphs cover the transport system's specifications from two levels. First, the general specifications are summarized. Following this, details of performance specification test conditions are given to help the user understand and achieve full specification performance of the transport system.

5.1 GENERAL SPECIFICATIONS

Table 1 defines the media, performance, functional, electrical, status, control, physical, and environmental specifications for the transport system.

TABLE 1 TRANSPORT SYSTEM SPECIFICATIONS

Item	Specification
TAPE MEDIA	Certified computer grade digital cassette. 300-foot length (91.4-meter) standard.
READ/WRITE PERFORMANCE	
Tape Speed	10 IPS standard. 10 to 20 IPS Optional
Start Time	70 milliseconds set by start delay in circuits.o
Stop Time	40 milliseconds maximum
IRG LENGTH	1 inch (2.54 cm) maximum

BIT ERROR RATE	Less than one bit error per 1×10^8 bits reading throughout tape.o
SEARCH PERFORMANCE	
Tape Speed	75 IPS average
Start Time	60 to 100 MS*.
Stop Time	100 to 150 MS*.
Start Distance	2.50 to 5.00 in. (6.35 to 12.7 cm)*.
Stop Distance	1.50 to 4.50 in. (3.81 to 11.43 cm)*.
REWIND TIME	48 seconds maximum for a standard 300-foot (91.4-meter) tape.
DATA HANDLING	
Density	800 BPI standard. Others opt.
Data Rate	8000 Baud (BPS) @ 10 IPS.
Encoding Technique	Phase encoding
Data Capacity	5.76 million bits (approx.) for a 300-foot tape and using both channels.
FUNCTIONAL	
Number of Heads	One
Tracks per Head	Two
Operating Modes	Bi-directional operation at both read/write and search speeds.
MOTOR DRIVE	Two direct drive, DC, servo-controlled motors employing reel to reel drive with constant gentle tape tension and torque braking (stop and constant torque braking while stopping.)

o See Performance Specifications Test Conditions in following text.
* Depends on cassette type and tape distribution within the cassette.

Item	Specification
ELECTRICAL	
I/O SIGNAL LEVELS:	All Standard Signals are TTL compatible (i.e., 0 and +5 VDC)
INPUT SIGNALS, TRANSPORT MOTION AND STATUS:	Forward/reverse, fast/slow, and go/stop are the three standard motion control signals. Solenoid power is available for a control option. The solenoid is used to lock the door.
OUTPUT SIGNALS, TRANSPORT MOTION AND STATUS:	Cassette presence, BOT/EOT (indicates clear leader or pierced tape), tape location indicates if tape used is greater than 50%), file protect, and tape motion are all standard status signals. Cassette side signal is optional.
INPUT SIGNALS, DATA HANDLING SECTION:	Write data enable, select read or write clock, read data enable, select head channel, NRZ serial data (Write)
OUTPUT SIGNALS, DATA HANDLING SECTION:	Write data start delay, read data complete, read strobe, NRZ Serial Data (Read), write strobe.
INPUT POWER SUPPLY:	Only one required, within range of 14 to 30 VDC, 800 MA maximum, 350 MA nominal.
POWER CONSUMPTION:	6 watts nominal @ 15VDC primary power.

PHYSICAL AND ENVIRONMENTAL

Dimensions (HxWxD)	4.65x4.90x5.30in. (11.81x 12.45x13.46cm)*
Weight	3 lbs (1.36kg)
Operating Position	Any orientation from vertical to horizontal
Operating Temperature	+32 to 140°F (0 to +60°C)**
Storage Temperature	-40 to +160°F (-40 to +71°C)
Operating Humidity	20 to 95% relative (non-condensing).

* Depth measured to end of edge card connector, such as TRW P/N 252-22-30-160 or equivalent, which is normally supplied by customer.

** If operation below 32°F is desired consult factory.

5.2 PERFORMANCE SPECIFICATION, TEST CONDITIONS AND DEFINITIONS

Following paragraphs define conditions under which the transport system performance specifications apply.

All performance specifications involving tape handling are based on using a certified, digital, test cassette. For specification purposes, no writing or reading of data is performed next to the clear leader splice at either end of tape, (such as the approximately five-inch distance specified in the ANSI standard defining Magnetic Tape Cassette for Information Interchange). Specifications apply only while operating within the specified range of ambient environment and specified range of required input power.

Start time is defined as the period between the time when the Tape Motion Input signal (pin 17) is made active low for a write operation and the time when the 70 millisecond Write Data Start Delay Output signal (pin H) goes active high indicating that the transport is up to speed and ready to receive and accurately write data. Select Read/Write (pin C) must also be in write (high) to receive a "Write Data Start Delay" signal. 70 ms was chosen as a "safe" value for most tapes. The amount of time necessary for start up is very dependent on the friction within the cassette (varies from one manufacturer to another) and the location of the tape within the cassette. Values other than 70 ms may be used if restrictions are put on the cassette.

Stop time is defined as the period between the time when "Tape Motion" (pin 17) is switched to the stop mode (high) and the time required for the tape to cease motion.

IRG (inter-record gap) length is defined as the distance between the last recorded bit of one record and the first recorded bit of the succeeding record. Such distance varies slightly due to the constantly changing tape loads and reel speeds from beginning of tape to end of tape. This difference requires more/less time to start/stop motion and, therefore varies the length of tape moved during the IRG. The IRG defined in Table 1 is a maximum value which includes: 1) Variations between BOT and EOT for the certified tape specified for use in this transport. 2) The transport system's built-in 70 millisecond start delay. 3) Variations observed when selecting various brands of certified tape.

Bit error rate is derived from long term test results using the following two methods.

Test number one is conducted by writing a 300-foot test cassette from end-to-end with continuous tape motion (no stop/starts for record gaps), and then repeatedly; reading the tape through, reversing direction, reading the tape through, etc. The data written on this test tape consists of uniform records of bits separated by uniform IRG's of approximately 0.3 inch (0.8 cm). Each record is structured as follows: a 10101010* 8-bit preamble, followed by an 8-bit recognition code, followed by 512 x 8 data bits, followed by an 8-bit recognition code, and ended by a 10101010* postamble.

Test number two is conducted by using a test tape written from end-to-end with the same records as Test Number One, but with actual stop and start record gaps of approximately 0.41 inch (1.0cm). Reading for this second test is done in a start/stop manner (i.e.: reading through, reversing direction, reading through, reversing direction, while starting and stopping between records.

Data capacity of the unit using the specified certified tape cassette assumes continuous recording of data bits from beginning to end of tape (no record gaps, all one record). Such recording must be done on both channels to achieve the stated data capacity.

*Note: Preamble and postamble are read from right to left, i.e., they start with "0" and end with a "1."

6. UNPACKING AND MOUNTING

6.1 UNPACKING

All systems are operationally checked before shipment from the manufacturer. Packaging conforms to acceptable standards for shipping electro-mechanical equipment. Before unpacking, inspect

shipping container for possible external, in-transit damage. If damage is evident, contact the carrier and the manufacturer and specify the nature and extent of damage. If no damage to the exterior of the shipping container is evident, open the container and remove the unit. Remove any protective covering and/or packing material from the unit. Verify that packing material is not lodged within the unit or adhering to the elctrical connector. If repacking the unit for further shipment, follow standard practices for such equipment, or re-use the container that the unit was received in.

6.2 MOUNTING

Page 1 of Specification 0050 (CS-400A Interface Specification) in the Appendix shows the mounting requirements for the unit. In general, unit positioning is at the user's discretion. However, for ease of use (inserting and removing tape cassettes with minimum risk of accidentally dropping one), recommended positioning is with the opening in the cassette chamber inclined toward the vertical when the chamber is open for cassette loading or unloading.

7. ELECTRICAL INTERFACE

7.1 GENERAL INTERFACE NOTATION AND DEFINITIONS

The transport system includes control electronics for the DC drive motors, data handling and conditioning, read/write functions, and TTL-to-head encoding/decoding. One, 44-pin, board-edge connector provides all external interface signals with the host system. Location of this connector and suitable mating connector appears in the CS-400A Interface Specification 0050, page 1 of 4 in the Appendix. Section 7.2 identifies and defines all the interface signals required on the 44-pin connector. Signals termed "input" are those required from the host system. Those termed "output" are issued from the transport to the system. References to "low (0)" and "high (1)" are to logic low (logic 0) and logic high (logic 1) circuit levels. Refer to page 2 of the previously mentioned Specification 0050 in the Appendix for a quick review of all the interface signals. In passing, it is worth noting that the descriptive terminology on page 2 referenced(and used elsewhere) uses a symbol ⇒ which stands for the word "implies".

The majority of the signals assigned to the interface connector pins are TTL-compatible, two level (high or low). TTL two-level signals are defined as follows for this transport system:

Input low (0) = 0 VDC to 0.8 VDC
Input high (1) = 2.0 VDC to 5.0 VDC

Output low (0) = 0 VDC to 0.4 VDC
Output high (1) = 2.4 VDC to 5.0 VDC

The maximum line length which these TTL driver/receiver circuits should operate on is 6 feet (1.8 meters).

The interface signals identified in Section 7.2 include all required control, status, data, power, ground returns, and chassis ground. Note: For checkout convenience, a variety of circuit test points are also provided by the transport system to the connector pins. Since these are not required operating signals, they (and likewise any spare pins) are not discussed in Section 7.2. For use of these extra pins, see the previously referenced "page 2" in the Appendix. Signals listed on "page 2" as TTL are 0 and 5V signals and signals listed as "CMOS" are 0 and 12V signals.

Pages 3 and 4 of Specification 0050 in the Appendix are an invaluable aid to understanding the transport system. These pages show the timing characteristics of the required I/O signals during both write and read operations.

7.2 I/O CONNECTIONS

7.2.1 CLEAR LEADER

Pin 01 Low ⇒ Clear leader (light)
High ⇒ Opaque oxide coated tape (dark)

TTL Output provided by the transport

Drives up to two TTL loads.

Has totem pole output between +5 VDC and 0 VDC

Indicates clear leader or pierced hole in tape.

Will respond to pierced hole in tape at all speeds.

May give meaningless information if thin audio grade tape is used.

Hole width is nominally 7 ms at 10 ips and 2 ms at 75 ips.

7.2.2 POWER GROUND

Pins 02 and B Motor return

Separate ground return from the two DC drive motors. *Must be electrically tied by the user to Logic Ground (pins 11,*

14 and R) somewhere in the users system. Carries the great majority of the supply return current. The rest is carried by Logic Ground, (pins 11, 14 and R). In systems where the transport is located at some distance from the users power supply this line is usually tied to Logic Ground also (pins 11, 14 and R) at the users power supply.

Pins 02 and B are tied in parallel inside the transport system.

7.2.3 TAPE MOTION STATUS

Pin 04 Low ⇒ No Motion
High ⇒ Motion

Output provided by the transport.

May be used to drive up to ten TTL loads *or* may be used to directly drive a LED with 14 ma. (assuming 1.6 VDC across the LED). Note: This output is not a TTL output if loaded with a LED.

Indicates tape motion in either direction and at both fast and slow speeds.

Has an internal pull-up (240 Ohms) to +5 VDC and a clamping transistor to ground.

7.2.4 CASSETTE PRESENCE

Pin 06 Low ⇒ Presence

TTL output, supplied by the transport.

Contact closure to "Logic Ground" (pins 11, 14 and R)

Has internal 4.7K pull up to +5 VDC.

Indicates cassette is present *and* door is in latched position ready to operate.

7.2.5 CHASSIS GROUND

Pin 07

Protective (safety) ground lines separated from all other grounds.

7.2.6 POWER (+14 to +30 VDC)

Pins 08 and J

Customer supplied power input to the transport system.

Only customer supply required.

May be any voltage from +14 to +30 VDC.

May be supplied as low as 12 VDC if certain performance specifications are non-critical.

Current drawn is independent of supply voltage.

A safe, nominal operating current to assume is 600 MA (not including solenoid). This value will vary depending on type of cassette used, location of tape within cassette.

Peak operating current may appear as high as 850 MA (motor's stalled) (not including solenoid).

Pins 08 and J are tied in parallel within the transport system.

7.2.7 DOOR SOLENOID (OPTIONAL)

Pin 09 Ground to activate

Input, supplied by customer if solenoid option is included. Solenoid has two possible configurations depending on operation required. Option "A", solenoid may inhibit door opening when energized, or, Option "B", permit door to be opened or closed when energized. Option "B" provides for door inhibit whenever the solenoid is "off" making it impossible to open or close the door until activated.

The solenoid is electrically located between "Door Solenoid" (pin 09) and "Power, +14 to +30 VDC" (pins 08 and J). The resistance of the solenoid will pull "Door Solenoid" (pin 09) to the power supply potential when it is not energized. The solenoid operating current is 54 MA when "Power" (pins 08 and J) is supplied at +14 volts. Since the solenoid is an option this current is in addition to the current specified elsewhere in this document as "operating current". This solenoid is diode protected within the transport system.

Operation of the solenoid below a supply voltage of 20 volts cannot be guaranteed if the unit is mounted with the door pivot at the top and the tape inserted from the bottom. If this orientation and a low operating voltage is required the customer should contact the factory.

7.2.8 LOGIC POWER, +5 VDC (±5%)

Pins 10 and S

TTL power *output* source *provided by the transport system*.

May be used by customer to power TTL circuits.

Capable of providing 525 MA if System Power (+14 to +30 VDC) (pins 08 and/or J) is 14 VDC.

Capable of providing 150 MA if System Power (+14 to +30 VDC) (pins 08 and/or J) is 30 VDC.

Current specifications for the transport are based on values observed when this output is unused.

Any current drawn from this output will cause an identical current increase in System Power (+14 to +30 VDC) (pins 08 and/or J).

Pins 10 and S are tied in parallel within the transport system.

7.2.9 LOGIC GROUND

Pins 11, 14 and R

Primary return for all signals of the transport system. *Must be tied externally to Power Ground (pins 02 and B) by the customer*. See information under "Power Ground" (pins 02 and B).

Pins 11, 14 and R are all tied in parallel within the transport system and should also be tied in parallel by the customer. *Warning:* Opening these lines with power applied will damage the transport system.

7.3.0 CASSETTE SIDE A/B (Optional)

Pin 12 Low ⇒ Side B Facing out (away from main chassis)

High ⇒ Side A Facing out (away from main chassis)

TTL output supplied by the transport when Cassette Side option is included.

Contact closure to "Logic Ground" (pins 11, 14 and R).

Has internal 4.7K pull-up to +5 VDC.

Meaningful only when cassette is present and door is closed. (i.e. meaningful only when "Cassette Presence" [pin 06] is active [low]).

High when no cassette is present, when door is open or when side A is facing out.

Meaningful only with cassettes which have the offset "Cassette Side" identification notch.

7.3.1 TAPE LOCATION STATUS

Pin 15 Low ⇒ First half of tape

High ⇒ Second half of tape

Output supplied by the transport.

May drive 1 TTL load-but can't be guaranteed to do so.

Totem pole output which is clamped at +5 VDC and 0 VDC.

Meaningful only during tape motion.

May be "anded" by user with "Tape Motion Status" (pin 04) and "Clear Leader" (pin 01) to give end of tape (EOT) signal.

Inverse may also be "anded" with "Tape Motion Status" (pin 04) and "Clear Leader" (pin 01) to give a beginning of tape (BOT) signal.

Signal is undefined near center of tape.

7.3.2 CASSETTE FILE PROTECT

Pin 16 Low ⇒ Tab not removed
High ⇒ Tab removed (write inhibit)

TTL output, supplied by transport.

Contact closure to "Logic Ground" (pins 11, 14 and R).

Has internal 4.7K pull-up to +5 VDC.

Low indicates that left hand tab has not been removed. (User facing transport from the front with door pivoting at the bottom).

Meaningful only when cassette is present and door is closed (i.e. meaningful only when "Cassette Presence" (pin 06) is active (low).

High when no cassette is present, when door is open, or when right hand tab has been removed.

Normally the system is implemented in a way such that writing is inhibited when the tab is removed.

7.3.3 TAPE MOTION

Pin 17 Low ⇒ Go
High ⇒ Stop

TTL input supplied by the user.

Requires 1.6 MA (max) of current sinking.

Has internal 4.7K pull-up to +5 VDC.

Controls Stop/Go motion of transport.

Note: Since a low signal on this line commands motion, this means that if the transport is powered up prior to the device that issues the command signals, tape motion will result.

Stop command applies braking to the transport.

When changing direction at low speed at least 40 MS of Stop command is recommended.

When changing direction at Search (fast) speed at least 150 MS of Stop command should be given *simultaneously* with a Slow speed command to assure smoothest tape handling.

7.3.4 TAPE SPEED

Pin 19 Low ⇒ Fast
High ⇒ Slow

TTL input, supplied by the user.

Requires 1.6 MA (Max) of current sinking.

Has internal 4.7K pull-up to +5 VDC.

Determines speed of transport. Slow is 10 ips on standard models and fast is 75 ips.

7.3.5 TAPE DIRECTION

Pin 20 Low ⇒ Forward
High ⇒ Reverse

TTL input, supplied by the user

Requires 1.6 MA max of current sinking.

Has internal 4.7K pull-up to +5 VDC.

Determines direction of transport.

Direction may be changed without stopping tape; however, it is not advised. For smoothest tape handling see recommendations under "Tape Motion" (pin 17). 7.3.3

7.3.6 WRITE DATA ENABLE

Pin A Low ⇒ IRG
High ⇒ Enable

TTL input, supplied by the user.

Requires 1.6 MA of current Sinking.

Standard TTL input with no internal pull-up.

Meaningful only when the system is in the write mode. (See notation under pin C, "Select Read/Write.") 7.3.7

When this line is in the IRG mode (low), the transport system erases previously recorded data and applies a continuous "one" on the tape. There are no flux changes written during this period.

(The procedure is per ANSI standard.)

When in the IRG mode (low) "Write Data In" (pin D) and "Write Clock" (pin E) have no effect on the constant "one" being written on the tape.

When this line is in the Enable mode (high) data is strobed from the "Write Data In" line (pin D) to the tape at the leading edge of every other "Write Clock" pulse (pin E). (See Specification 0050, P3 in Appendix)

This line may be shifted to the Enable mode (high) when Select Read Write (pin C) is in write (high) and the transport is up to speed (i.e. when Write Data Start Delay (pin H) is high).

This line must be shifted to the IRG mode (low) on either edge or during the first "Write Data Strobe" (pin F) following the last bit of the postamble.

7.3.7 SELECT READ/WRITE

Pin C Low ⇒ Read
High ⇒ Write

TTL input, supplied by the user.

Requires 1.6 MA of current sinking.

Standard TTL input with no internal pull-up.

Determines Read/Write mode of the system.

May be changed from one mode to the other any time the "Write Data Enable" (pin A) line is in the IRG mode (low). In the Write mode the transport will erase all previously recorded information on the channel selected.

Note: This line must always be in the Read mode (low) whenever power is applied to, or removed from the transport system. If this is not done, extraneous information may be written in the IRG.

7.3.8 WRITE DATA IN

Pin D Low ⇒ 0
High ⇒ 1

TTL input, supplied by the user.

Requires 1.6 MA of current sinking.

Standard TTL input with no internal pull-up.

Data input line, presents the digital information to be written on the tape.

Is sampled by the first leading edge (and every other leading

edge thereafter) of the Write Clock after "Write Data Enable" (pin A) has been placed in the Enable mode (high).

May be changed after the first leading edge and prior to the third leading edge of the Write Clock, etc.

A convenient method of determining when the data may be changed is available in the form of the "Write Data Strobe" (pin F). (See description listed under "Write Data Strobe".)

"Write Data In" (pin D) may be changed on either edge of, or during "Write Data Strobe" (pin F).

Note: It is necessary to have the first bit of the preamble on this line prior to enabling "Write Data Enable" (pin A).

The bit rate on this input is nominally 8000 baud at 800 BPI and 10 IPS.

The acceptable write bit rate is actually dependent on the data rate experienced during read. If an attempt is made to recover data at search speeds a low speed, low density write must be used. (See discussion under "Read Data Out" (pin N). 7.4.4

Data *must* be written in compliance with the restrictions listed under "Record Formatting" (section 8.1).

7.3.9 WRITE CLOCK

Pin E

TTL input supplied by the customer.

Requires 1.6 MA of current sinking.

Standard TTL input with no internal pull-up.

This signal *must be synchronous with the data and* must be at a rate *twice the frequency of the data*. (Nominally 16 KHz on standard 800 BPI, 10 IPS machines.)

The leading edge of this signal clocks the data onto the tape.

The leading edge is the only meaningful portion of this signal.

It may be disabled while writing the IRG and during Read, or it may be left running continuously.

7.4.0 WRITE DATA STROBE

Pin F Low during read and while writing IRG.

High indicates data has been written, and new data is needed.

TTL output supplied by the transport system.

Drives up to two TTL loads.

Totem pole output between 0 V and +5 VDC.

Synchronous with "Write Clock" (pin E) and at 1/2 the rate of "Write Clock".

Starts running when Select Read/Write (pin C) is in Write (high) and "Write Data Enable" (pin A) is in the Enable mode (high).

"Write Data Strobe" (pin F) is low when it is not running.

Strobe width is approximately 8 us.

This strobe is provided as a convenient means to indicate the existing data has been written and new data is desired.

Either edge of this strobe may be used by the customer to change the data on the data line. In the event the customer is shifting data out of a shift register and the data is to be written on the tape, this strobe may be used to shift the shift register.

The first strobe following the postamble should also be used to drop "Write Data Enable" back into the IRG mode (low).

7.4.1 WRITE DATA START DELAY

Pin H Low ⇒ Do not write
High ⇒ Ok to write

TTL output supplied by the transport system.

Drives up to 2 TTL loads.

Totem pole output between 0 V and +5 VDC.

Signal appears approximately 70 MS after "Tape Motion" (pin 17) has been placed in the Go mode (low) and select Read Write (pin C) has been placed in Write (high).

It reverts to the low state when "Tape Motion" (pin 17) is placed in the Stop mode (high) or when Select Read Write (pin C) is placed in Read (low).

It is provided as a convenient means to assure that the transport is up to speed prior to entering data on the tape.

This signal is not used elsewhere in the transport and may be ignored if the customer wishes to externally control the Write delay.

7.4.2 DATA COMPLETE

Pin K Low going pulse ⇒ Data complete

TTL output supplied by the transport system.

Drives up to two TTL loads.

Totel pole output between 0 V and +5 VDC.

Signal width approximately 300-500us.

Signal appears when "Read Data Out" (pin N) and "Read Strobe Out" (pin M) have remained inactive for 2.8 MS at either 10 IPS or 75 IPS.

Signal may be used to count records at either speed.

If signal is to be used, records must consist of at least 32 bits at 800 BPI and 10 IPS (including preamble and postamble).

At least seven extraneous transitions may be located in an inter-record gap without the signal interpreting them as a record.

Operation of signal is not dependent on status of "Read Data Enable" (pin P).

7.4.3 READ STROBE OUT

Pin M High ⇒ Valid Data

TTL output supplied by the transport system.

Drives up to two TTL loads.

Totem pole output between 0V and +5 VDC.

Indicates presence of valid data bit on "Read Data Out" (pin N).

Data is valid during and on both edges of this strobe.

Strobe width is approximately 2us.

Strobe occurs approximately 2-6us after new data has been presented on "Read Data Out" (pin N).

Valid only during a record.

Active only when "Read Data Enable" (pin P) is in the Read mode (high) and "Select Read/Write" (pin C) is in Read (low).

Remains low during Write and when "Read Data Enable" (pin P) is in the inhibit mode (low).

Strobe is produced at rate data was entered on tape. (e.g. 8000 baud at 10 IPS and 800 BPI.)

Meaningless at search speed unless data was written on the tape using a low density such that the "Read Data Out" (pin N) and "Read Strobe Out" (pin M) rates are 8000 baud at search speed.

Remains low during read when "Read Data Enable" (pin P) is in the inhibit mode (low).

7.4.4 READ DATA OUT

Pin N   Low ⇒ 0
         High ⇒ 1

TTL output supplied by transport system.

Drives up to two TTL loads.

Totem pole output between 0 V and +5 VDC.

Data output line produces NRZ (i.e. digital) data that has been written on the tape.

Data is presented at same rate (± 5%) as that which was used during writing (i.g. 8000 baud at 10 IPS and 800 BPI).

Valid only during a record.

Retains state that existed when "Read Data Enable" (pin P) was put in the inhibit mode (low).

Remains inactive during read when "Read Data Enable" (pin P) is in the inhibit mode (low).

Standard model will produce valid data only if it was written at a rate such that the rate during read is between 4700 and 10,000 baud.

Meaningless at search speed unless data was written on the tape using a low density such that "Read Data Out" (pin N) and "Read Strobe Out" (pin M) rates are 8000 baud at search speeds.

Although meaningful data can be attained at search speeds by using lower densities, it should not be considered to be reliable.

When reading Data written forward in the reverse direction the data observed on this line will be inverted.

7.4.5 READ DATA ENABLE

Pin P   Low ⇒ Inhibit
         High ⇒ Read

5 or 12 volt input supplied by the user. (Guaranteed "On" level is 2.0 volts.)

Requires 78 ua of current *sourcing*.

Meaningful only when "Select Read Write" (pin C) is in the Read mode (low).

May be used by the customer to inhibit operation of "Read Strobe Out" (pin M) and "Read Data Out" (pin N). This is normally done during rewind or when the transport is known to be in an Inter Record Gap.

Note: Must be tied high if it is not used.

When in the inhibit mode "Read Strobe Out" (pin M) will remain low and "Read Data Out" (pin N) will retain its last state.

This means that "Read Data Out" (pin N) will be in the One mode (high) during an Inter-Record Gap since the post-amble ends in "1" (as per ANSI standard).

7.4.6 SELECT HEAD CHANNEL

Pin U Low ⇒ Channel 2 (outside track)
  High ⇒ Channel 1 (inside track)

TTL input supplied by the user.
Requires 1.6 MA of current sinking.

Standard TTL input with no internal pull-up to +5 VDC.
Determines active channel of system.

7.4.7 OPERATING MODES

As can be seen by the preceding Electrical Interface definitions, the transport system requires just three motion command signals via the controlling interface. These three commands are:

- Forward (L)/Reverse (H) on pin 20.
- Fast (L)/Slow (H) on pin 19.
- Go (L)/Stop (H) on pin 17.

Standard search speed is 75 IPS and standard read/write speed is 10 IPS. These apply in either direction.

Due to the two channel feature and bi-directional operation, the customer may wish to write one track, change direction, switch channel and then write the other track. This mode of operation eliminates the necessity to rewind.

Interface signal timing is critical for proper transport system operation in any mode. Pages 3 and 4 of Specification 0050, "CS-400A Cassette Transport System Interface Specification" show the critical timing for the write and read modes. These waveforms show that the Select Read/Write Input (pin C) signal level must be determined by the host electronics before starting tape motion. This is necessary to prevent accidental (or unwanted) writing. Also shown by the waveforms is that once writing is selected and enabled via pins C, H, and A (assuming File Protect pin 16 is inactive

high), then NRZ data input (pin D) will be strobed onto tape at the leading edge of every second high going Write Clock Input (pin E). In addition, the diagram shows that IRG condition is a high (logic 1) polarity. A read is, of course, a reproduction of what was written. Reading the written preamble synchronizes the Read Strobe Out signal (pin M). For further details of either the read or write functions, see the notes on the timing diagram.

Since the write and read mode timing diagrams illustrate the critical timing for all operating modes, no waveforms appear in Specification 0050 for search forward or search reverse (rewind) modes. These two fast modes operate like a read operation, however, with the speed (and direction in the case of search reverse) changed. For the case of changing tape directions at either slow or fast speed, Figures 2 and 3 provide additional details. *Especially* take note of the timing tolerances shown in these two figures.

If the customer desires, he may disregard the stop command in figure 2 and change directions without going through stop at slow speeds.

Applications also exist where direction is being changed at search speed without a stop command and applications exist where a short burst of high speed reverse is being used for faster braking. If the customer wishes to use either of these modes he is urged to contact the factory.

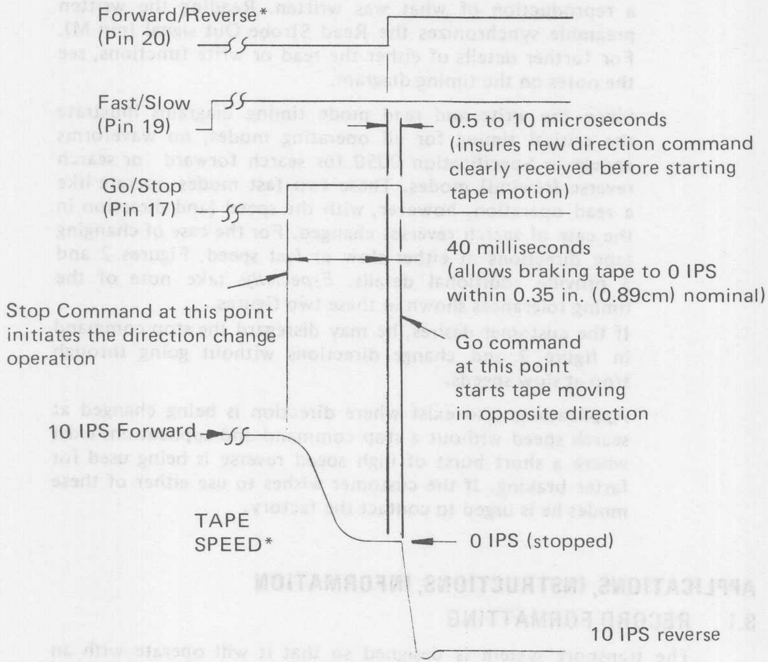
8. APPLICATIONS, INSTRUCTIONS, INFORMATION

8.1 RECORD FORMATTING

The transport system is designed so that it will operate with an ANSI compatible format. Although the transport system does not require the implementation of such a format, it does require certain formatting precautions and they follow:

8.1.1 USE OF A PREAMBLE

The user must place an 8 bit 10101010 preamble prior to every record. The purpose of the preamble is to synchronize the data decoding electronics located in the transport system



* For changing from reverse slow to forward slow, forward/reverse signal (Pin 20) and tape speed waveform are each opposite that shown here. Otherwise, the same timing requirements apply.

Figure 2. Change Tape Direction at Slow (Read/Write) Speed

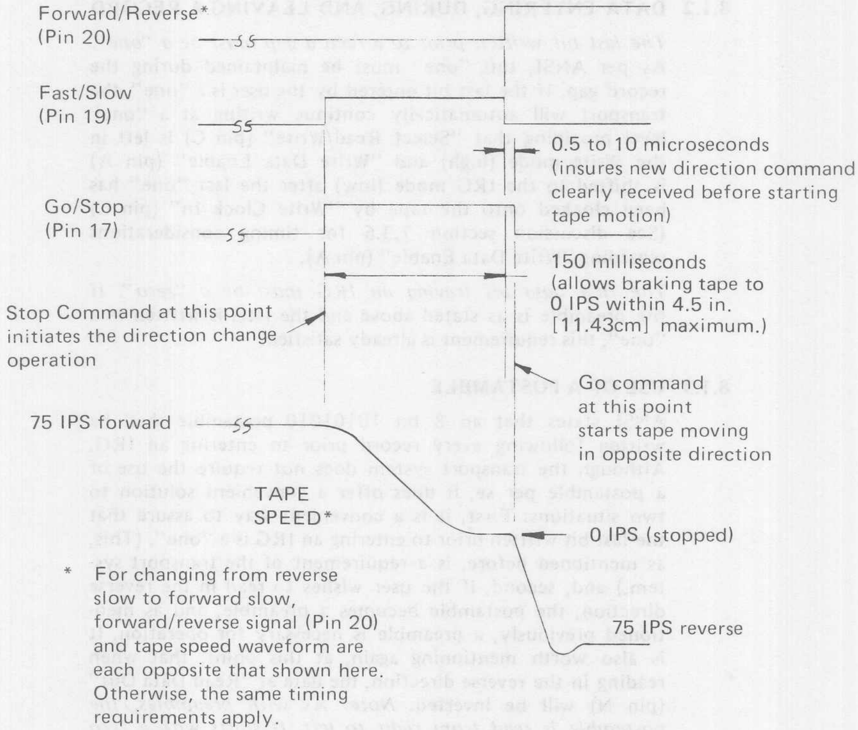


Figure 3. Change Tape Direction at Fast (Search) Speed

with the data coming off the tape. The ANSI requirement is for 8 bits of preamble and that is what is required for use with this system. *Note: It is convention to read the preamble above from right to left.* The preamble therefore starts with a "0" and ends in a "1".

8.1.2 DATA ENTERING, DURING, AND LEAVING A RECORD

The last bit written prior to a record gap must be a "one". As per ANSI, this "one" must be maintained during the record gap. If the last bit entered by the user is a "one", the transport will automatically continue writing at a "one" level providing that "Select Read/Write" (pin C) is left in the Write mode (high) and "Write Data Enable" (pin A) is shifted to the IRG mode (low) after the last "one" has been clocked onto the tape by "Write Clock In" (pin E) (See discussion section 7.3.6 for timing considerations regarding "Write Data Enable" (pin A).

The first data bit leaving an IRG must be a "zero". If the preamble is as stated above and the IRG is written as a "one", this requirement is already satisfied.

8.1.3 USE OF A POSTAMBLE

ANSI states that an 8 bit 10101010 postamble shall be written following every record prior to entering an IRG. Although the transport system does not require the use of a postamble per se, it does offer a convenient solution to two situations: First, it is a convenient way to assure that the last bit written prior to entering an IRG is a "one". (This, as mentioned before, is a requirement of the transport system.) and, second, if the user wishes to read in the reverse direction, the postamble becomes a preamble, and as mentioned previously, a preamble is necessary for operation. It is also worth mentioning again, at this point, that when reading in the reverse direction, the data at "Read Data Out" (pin N) will be inverted. *Note: As with preambles, the postamble is read from right to left. It starts with a zero and ends in a one.*

8.1.4 USE OF A CHARACTER RECOGNITION CODE

Present models of the CS-400A Transport System do not require the use of a character recognition code. In the past a character recognition code has been used if there was a possibility of losing a bit of preamble. If the amount of preamble is uncertain the user has no way to determine

where the preamble ends and the data starts. Hence the use of a distinctive character preceeding each data block (i.e. a character recognition code). When this character was observed the user would know that data follows immediately.

The CS-400A reliably reproduces all eight bits of preamble. The user therefore, may expect data to follow each time he recognizes an eight bit preamble.

If the user already has a system structured with a character recognition code, the CS-400A will reproduce it along with the preamble and no incompatibility will result.

8.2. START AND STOP DELAY

8.2.1 START DELAY

A delay between the command to start motion and the first data on the tape is needed to insure that the tape is near operating speed prior to writing data. When data is written with the use of a start delay, it will appear at a uniform rate during read. A start delay of approximately 70ms is suggested for use with the CS-400A transport system. A delayed output is provided which may be used as a start delay, see discussion under section 7.4.1 Write Data Start Delay (pin H).

The user may wish to create his own start delay if he desires a value other than the 70ms provided by the transport. If this is done two primary things should be considered in selecting the value, first: different types of cassettes will come up to speed at different rates, and the same cassette will come up to speed at different rates depending on the location of the record within the cassette, second: the type of decoding scheme is extremely important in the selection of a start delay. The "Auto Sync" decoding scheme incorporated in the CS-400A system will accept extreme changes in data rate. If schemes other than "Auto Sync" are used (e.g. if the tapes are to be read on other manufacturer's machines) the data rate acceptance tolerances of the other machines should be investigated prior to selecting a start delay.

8.2.2 STOP DELAY

The necessity of a stop delay is a little less self evident than that of a start delay. A stop delay is a delay which is inserted between the last bit written and the issuance of a stop motion command. It is normally used when data is approached from one direction and then read in the opposite direction. For example, if the transport is reversing to re-read a record, a

stop delay assures that the location when stopped will be far enough into the record gap so that the transport will have adequate time to start up prior to receiving the data again. When choosing a stop delay the user should remember that the delay must satisfy all locations on the tape.

8.2.3 AREAS OF CONSIDERATION WHEN EDITING AND CHANGING DIRECTION

Rather than present all the various types of procedures that may be used with editing, a few important facts will be presented. They will be followed by points the user may wish to evaluate in regards to his proposed procedure.

Some of the facts to be considered are the time and distance necessary to reach a given tape speed (or to stop from a given speed). They are dependent primarily on: Tape speed, the location of the tape within the cassette, the direction of tape movement (e.g. at a particular location the stop distance may vary greatly depending on direction of approach), the brand of cassette and temperature.

Aware of the above variables the user should then ask himself the following questions as he conceives a format. Will a record which is "edited" or "dubbed in" be in the same position as the old one? If it is shifted slightly, will the next record gap be too short? Have I shortened the record gap by editing? If so, will an additional edit shorten it even more? When does it become "too short"? If there is a possibility of approaching the record from either direction, will the change in start and stop time cause similar change in record location and shortening of IRG as that just mentioned? If I am depending on stopping in an IRG when stopping directly from Search speed, is the IRG long enough, or will the machine coast through the IRG and into the next record prior to stopping? Have I created a situation where by dubbing in a short record in place of a long one will leave part of the old record present, and if so will this cause a problem? Will the additional record gap created confuse the record counting software? (if employed). If I have dubbed in a new record and reassigned an address code, has the old address code been erased so that it appears only once on the tape? (An address code is an identifier at the beginning of each record which identifies address.

If I am depending on data to be read in a direction opposite to that written, have I inserted the appropriate postamble, and address code (if used) at the end of the record, and

have I provided the signal inverter to invert the signal and make it meaningful? (see discussion section 7.4.4)

The preceding questions should assist the user in avoiding some of the pitfalls encountered in tape formatting. Some of the questions are applicable only to a limited number of situations and therefore may be totally irrelevant to many other situations, in which case they should be considered and then disregarded.

8.4 RECOMMENDED TYPICAL SEQUENCE OF SIGNALS

The following sequences are inserted as typical or recommended sequences. They are intended to produce optimum performance from the transport. The use of these sequences will provide: a format which may be made ANSI compatible, the smoothest tape handling operation, a minimum of extraneous information in the record gap, a maximum of flexibility to facilitate editing, high speed address search, and address location in the reverse direction.

These sequences deal only with the sequencing of the I/O signals. No attempt is made in this section to consider formatting. It is discussed elsewhere (see section 8.1).

The sequences presented are not absolute and may be modified and altered to a large degree. Satisfactory operation will still be observed. Customers with questions are encouraged to contact the factory and discuss their specific applications.

8.4.1 RECOMMENDED WRITE SEQUENCE

NOTE: The order of performing specific operations within a sequence step is not important, e.g. 4 B may be performed prior to 4A.

1. *Power up in Read Mode*
   a. Apply primary power (pins 08 and J)
   b. Ascertain that "Select Read/Write" (pin C) is in Read mode (low).
   c. Ascertain that "Tape Motion (pin 17) is in stop mode (high).
2. *Insert Tape*
   a. Insert tape, close door
3. *Rewind or Search*
   a. Rewind or search tape to Beginning of Tape (BOT) or desired Inter Record Gap (IRG). Tape must not stop in a record.
4. *Set Status of Control Lines Prior to Writing*
   a. Ascertain that "Write Data Enable" (pin A) is in

IRG mode (low).

b. Ascertain that "Write Data in NRZ" (pin D) is in the zero mode (low). (This is the first bit of the preamble).

c. Ascertain that "Tape Direction" (pin 20) is in mode desired.

d. Ascertain that "Tape Speed" (pin 19) is in Slow mode (high).

e. Ascertain that "Select Head Channel" (pin U) is in mode desired.

5. *Place the Unit in the Write Mode*

a. Place "Select Read/Write" (pin C) in write mode (high).

6. *Start Forward Motion*

a. Place "Tape Motion (pin 17) in Go mode (low). (This also starts "Write Data Start Delay".) The unit will now erase any previously written material and write a clean IRG.

7. *Machine Comes Up to Speed*

a. After approximately 70 MS "Write Data Start Delay" (output) (pin H) will go to the Enable mode (high).

8. *Verify System is Ready to Write Data*

a. Ascertain that the "Write Clock In" (pin E) is operating (may be on continuously if desired).

9. *Discontinue Writing IRG, Start Writing Data*

a. Use the presence of "Write Data Start Delay" (pin H) to bring "Write Data Enable" (pin A) to the Enable mode (high). Data will now be entered on the tape.

10. *Change Data Synchronously with Clock*

a. Data will be entered on the tape as per the timing diagram in the appendix (Specification 0043). Write data in NRZ (pin D) should be changed on either edge of or during the strobe.

11. *Make Last Bit Written a "One"*

a. Prior to returning to the IRG mode "Write Data in NRZ" (pin D) must be returned to the "one" state (high).

12. *Discontinue Writing Data, Write IRG*

a. Return "Write.Data Enable" (pin A) to the IRG mode (low) on the next "Write Data Strobe" (pin F), see timing diagram page 3 of Spec 43 in appendix.

13. *Continue to Write IRG*
    a. Continue to write the IRG for the desired amount of time. This is particularly necessary if editing is to be considered. (See discussion under section 8.2.3). This section of IRG is sometimes referred to as the "Stop Delay". Delete the stop delay if editing is not used. (See discussion under section 8.2.2).
14. *Stop Motion*
    a. After the desired amount of "Stop Delay" (if any) has been inserted, place "Tape Motion" (pin 17) in Stop mode (low).
15. *Allow Machine Time to Stop*
    a. After machine has had time to stop (approximately 40MS) place "Select Read/Write" (pin C) in Read mode (low if desired.)Allow the machine to stop prior to leaving the write mode to assure that all extraneous information is removed from the record gap. When switching from Write to Read care must be used to assure that the switch does not take place in the middle of an old record. If the transport receives a partial record without the preamble (during read) meaningless data will result.

8.4.2 RECOMMENDED READ SEQUENCE

1. *Power up in Read Mode*
    a. Apply primary power (pins 08 and J)
    b. Ascertain that "Select Read/Write" (pin C) is in Read mode (low).
    c. Ascertain that "Tape Motion (pin 17) is in Stop mode (high).
2. *Insert Tape*
    a. Insert tape, close door.
3. *Prepare to Rewind Tape*
    a. Set "Tape Direction" (pin 20) to reverse (high).
    b. Ascertain that "Read Data Enable" (pin P) is in the inhibit mode (low).
4. *Rewind*
    a. Set "Tape Motion" (pin 17) to go (low).
5. *Stop on Hole in Tape or Clear Leader*
    a. Set "Tape Motion (pin 17) to stop (high) when "Clear Leader" (pin 01) appears (high).
6. *Allow Machine to Stop*

a. Allow 150 ms for machine to stop

7. *Prepare to Search*
   a. Set "Tape Direction" (pin 20) to forward (low).
8. *Search*
   a. Set Tape Motion (pin 17 to go (low).-
9. *Count Records*
   a. Count "Data complete" (pin K) pulses (low) to determine location on tape.
10. *Shift to Slow When Approaching Desired Record*
    a. Prior to reaching the desired record switch "Tape Speed" (pin 19) to slow (high). This will allow the user to approach the desired record at slow speed. The user will have to determine the exact timing of this "switch" after considering the length of his records.
11. *Enable Read Data*
    a. After receiving the appropriate number of "Data Complete" pulses (pin K) set "Read Data Enable" (pin P) to the Read mode (high). This will permit "Read Data Out" (pin N) and "Read Strobe Out" (pin M) to function. As data appears on the tape it will now be decoded and appear on "Read Data Out" (pin N) and "Read Strobe Out" (pin M).
12. *Data Complete Pulse Appears*
    a. The presence (high) of "Read Strobe Out" (pin M) during a record indicates that there is data on "Read Data Out" (pin N) and that data is present and valid. This signal is often used to clock data into a shift register. "Read Data Out" (pin N) is valid during this strobe and on both edges of it. Strobe width is approximately 2us. When there is no more data (i.e. no transitions) on the tape, this line will go inactive (low).
13. *Data Complete Pulse Appears*
    a. Approximately 2.8MS following the last "Read Strobe Out" pulse (pin M) (i.e last transition of the record) the "Data Complete" pulse (pin K) will appear (low). This signal may be used to inhibit the customer's "Read Data" circuits and stop the transport. The " Data Complete" pulse is approximately 300-500 us in duration and as mentioned before is *low*.
14. *Disable Read Data*
    a. After the last character has been received (i.e.

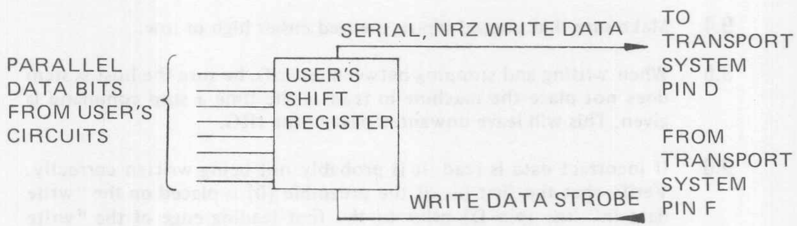
the postamble) "Read Data Enable" (pin P) may be shifted to the Inhibit mode (low). This will make "Read Data Out" (pin N) and "Read Strobe Out" (pin M) both inactive. In the inactive state "Read Strobe Out" (pin M) remains low and "Read Data Out" (pin N) retains the state of the last bit (i.e. normally remains high).

15. *Stop Transport*
   a. If it is desired to stop the unit "Tape Motion" (pin 17) may be placed in the Stop mode (high) any time after the last data has been received. In many cases the Stop command is issued at the same time "Read Data Enable" (pin P) is placed in the inhibit mode (low).

8.5 TYPICAL DATA TRANSFER CIRCUITS

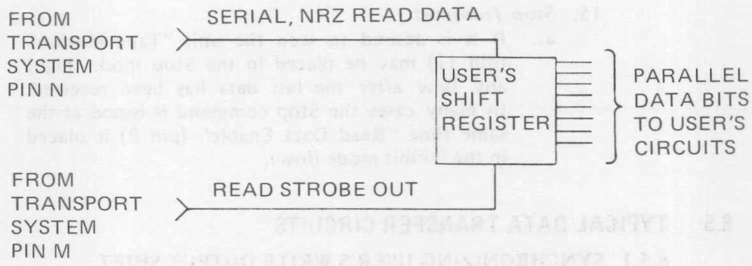
8.5.1 SYNCHRONIZING USER'S WRITE OUTPUT SHIFT REGISTER

The user may synchronize shifting NRZ Write Data to the transport system (pin D) from a parallel-load,serial-out, shift register by using the transport system's output signal from pin F. This signal is a clock pulse which runs at 1/2 the rate of the Write Clock Input (pin E), while data is being written on the tape. A typical user's circuit application is as follows:



8.5.2 SYNCHRONIZING USER'S READ INPUT SHIFT

The user may synchronize shifting NRZ Read Data (pin N) into a serial-input shift register by using the Read Strobe Out signal from the transport system pin M. The circuit could operate as follows:



9. PRECAUTIONS: Listed below are some of the common oversights made in utilizing the CS400A. If problems arise, carefully check each of the points below.

9.1 Wait for the machine to stop before changing the direction command. Do not change direction at the same time a stop command is given.

9.2 Make sure the power ground and logic ground are tied externally.

9.3 Make sure that outputs are not overloaded by other devices. Remember that some gate inputs look like low impedances when power is not applied to the gate.

9.4 Make sure that unused inputs are tied either high or low.

9.5 When writing and stopping between records, be sure the host system does not place the machine in read at the time a stop command is given. This will leave unwanted data in the IRG.

9.6 If incorrect data is read, it is probably not being written correctly. Verify that the first bit of the preamble (0) is placed on the "write data in" line (pin D) prior to the first leading edge of the "write data strobe" (pin F).

9.7 If incorrect data is read, verify that the "write data enable" line (pin A) is left inthe IRG mode (low) until the machine comes up to speed; i.e. until the "write data start delay" line (pin H) goes high.

10. MAINTENANCE:

The CS400A requires a minimum of maintenance. The only routine maintenance suggested is periodic cleaning of the head with isopropyl alcohol when a visible residue appears.

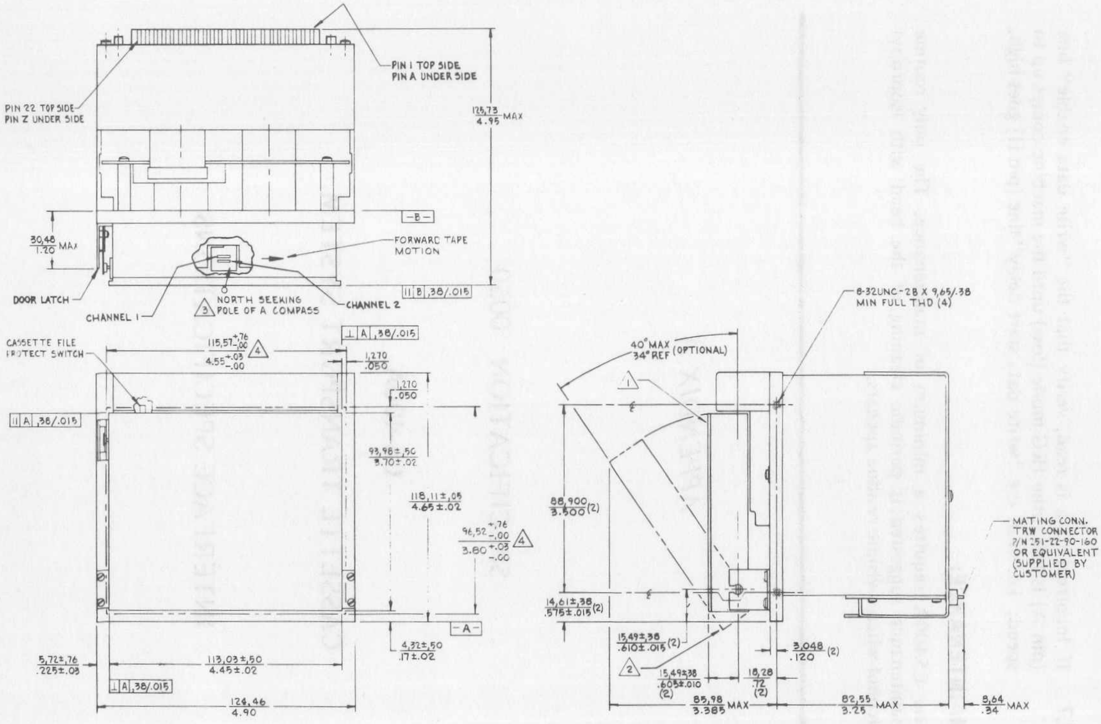
APPENDIX A

SPECIFICATION 0050

CS-400A

CASSETTE TRANSPORT SYSTEM

INTERFACE SPECIFICATIONS



4 - SUGGESTED DOOR PANEL CUTOUT
3 - WITH A "1" PRESENT ON PIN D (SEE PAGE 2), HEAD POLARITY AS SHOWN
2 - NOTE DOOR EDGE CLEARANCE NECESSARY WHEN DETERMINING MOUNTING DIMENSIONS
1 - CLOSING FORCE AT UPPER EDGE IN CLOSED POSITION IS ADJUSTABLE

MODEL CS400A — CASSETTE TRANSPORT	SPEC 0050 PAGE 1

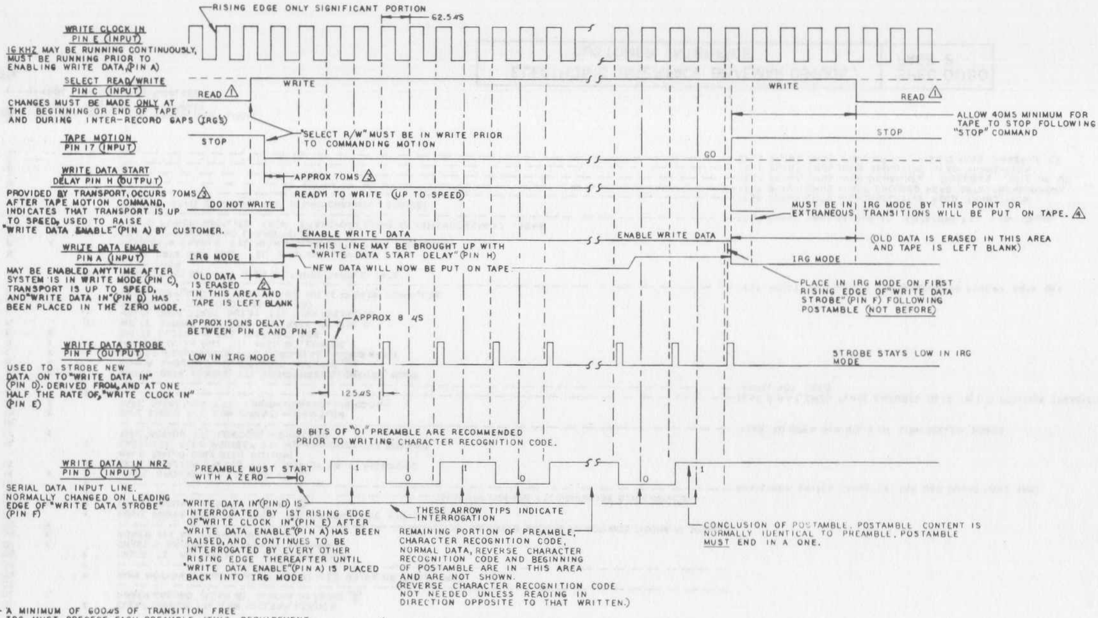
PIN NO.	INPUT	OUTPUT	STANDARD SYSTEM PIN DESCRIPTIONS	OPTIONS PIN DESCRIPTIONS	TEST POINTS AND SPARES PIN DESCRIPTIONS
01		X	CLEAR LEADER TTL LOW ⇒ CLEAR LEADER		
02	X		POWER GROUND (ALSO B) (MOTOR RETURN) ⚠2		
03					
04		X	TAPE MOTION STATUS 14 MA AT 1.6 VDC LED DRIVE OR TTL OUTPUT		
05		X			
06		X	CASSETTE PRESENCE TTL LOW ⇒ PRESENCE		
07	X		CHASSIS GROUND (NOT POWER GROUND)		
08	X		POWER +14 TO +30VDC (ALSO J)		
09	X			DOOR SOLENOID GROUND TO ACTIVATE (150MA AT 30VDC)	
10		X	LOGIC POWER SUPPLIED FROM TRANSPORT +5VDC ±5% AT 150MA		
11	X	X	LOGIC GROUND ALSO (14 AND R) ⚠2		
12		X		CASSETTE SIDE A/B TTL LOW ⇒ SIDE B, HIGH ⇒ SIDE A	
13		X			AUXILIARY SWITCH, CASSETTE TAB USE (RIGHT HAND TAB)
14	X	X	LOGIC GROUND ALSO (R AND 11) ⚠2		
15		X	TAPE LOCATION STATUS TTL LOW ⇒ 1ST HALF HIGH ⇒ 2ND HALF (VALID ONLY WITH MOTION)		
16		X	CASSETTE FILE PROTECT TTL HIGH ⇒ PROTECT (TAB REMOVED)		
17	X		TAPE MOTION TTL LOW ⇒ GO, HIGH ⇒ STOP		
18					SPARE, TO OPEN PIN NO. 3 OF CONTROLLER BOARD
19	X		TAPE SPEED TTL LOW ⇒ FAST, HIGH ⇒ SLOW		
20	X		TAPE DIRECTION TTL LOW ⇒ FORWARD, HIGH ⇒ REV		
21		X			TEST POINT, CMOS PHASE ENCODED DATA IN, 1 IS POSITIVE TRANSITION
22					SPARE, NOT USED
A	X		WRITE DATA ENABLE TTL HIGH ⇒ ENABLE, LOW ⇒ IRG MODE		
B	X		POWER GROUND (ALSO 2) (MOTOR RETURN) ⚠2		
C	X		SELECT READ/WRITE TTL LOW ⇒ READ, HIGH ⇒ WRITE		
D	X		WRITE DATA IN NRZ TTL HIGH ⇒ 1, LOW ⇒ 0		
E	X		WRITE CLOCK IN TTL HIGH ⇒ CLOCK		
F		X	WRITE STROBE OUT TTL 1/2 RATE OF PIN E		
H		X	WRITE DATA START DELAY TTL HIGH ⇒ ENABLE		
J	X		POWER +14 TO +30VDC (ALSO 08)		
K		X	DATA COMPLETE TTL LOW GOING PULSE ⇒ DATA COMPLETE		
L		X			TEST POINT, TTL HIGH ⇒ TIME WINDOW TO ACCEPT DATA BIT
M		X	READ STROBE OUT TTL HIGH ⇒ STROBE, SAMPLE DATA WHEN HIGH		
N		X	READ DATA OUT NRZ TTL HIGH ⇒ 1, LOW ⇒ 0		
P	X		READ, DATA ENABLE TTL HIGH ⇒ READ (WITH PIN C LOW ALSO)		
R	X	X	LOGIC GROUND (ALSO 11 AND 14) ⚠2		
S		X	LOGIC POWER SUPPLIED FROM TRANSPORT (SAME AS 10) +5VDC ±5% AT 150MA		
T	X				TEST POINT, SAME AS PIN 17 (GO/STOP) TTL LOW ⇒ GO
U	X		SELECT HEAD CHANNEL TTL HIGH ⇒ CHANNEL 1 (INSIDE)		
V		X			TEST POINT, CMOS HIGH ⇒ NEGATIVE READ TRANSITION
W		X			TEST POINT, CMOS PHASE ENCODED READ DATA, TRANS ⇒ PEAK
X		X			TEST POINT, CMOS HIGH ⇒ CHANNEL 1 (FOLLOWS STATE OF U)
Y					TEST POINT, CMOS HIGH ⇒ POSITIVE READ TRANSITION
Z		X			TEST POINT, CMOS LOW ⇒ WRITE, HIGH ⇒ READ (INVERSE C)

⚠2 – CUSTOMER MUST TIE POWER AND LOGIC GROUND TOGETHER EXTERNALLY

1 – SYMBOL ⇒ DENOTES "IMPLIES"

NOTE:

ELECTRONIC INTERFACE BRAEMAR CS400A, CUSTOMER INTERFACE	SPEC 0050 PAGE 2



NOTE:

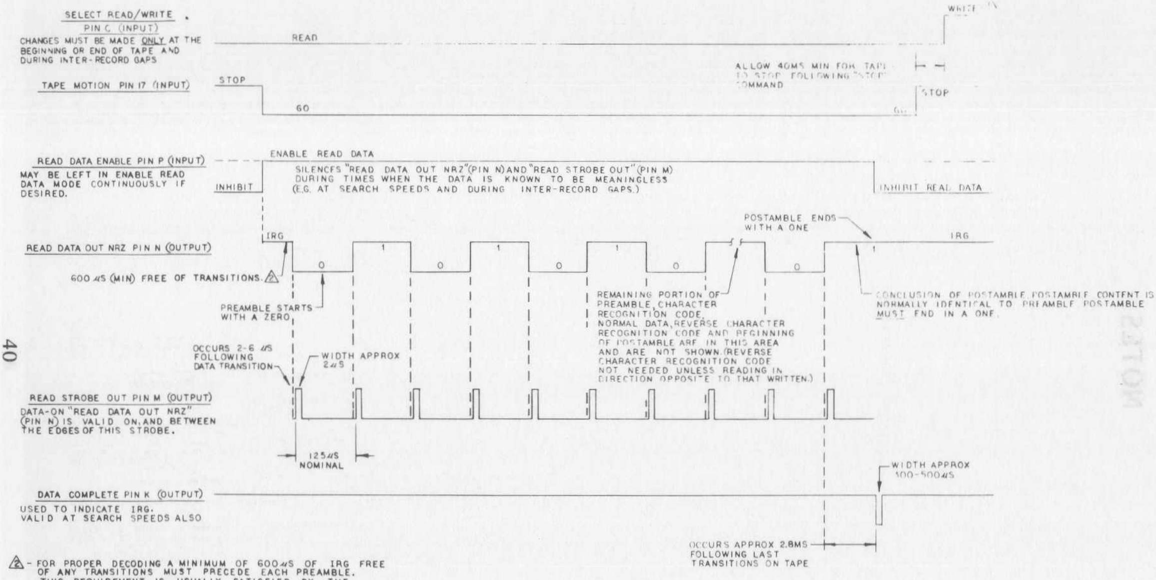
1 - SEQUENCE SHOWN ASSUMES THAT SYSTEM IS STOPPED AND IS IN READ PRIOR TO, AND FOLLOWING THE WRITE PERIOD. IF THE USER WRITES SEVERAL RECORDS SEQUENTIALLY WITHOUT STOPPING, "SELECT READ WRITE" (PIN C) SHOULD REMAIN IN WRITE THROUGHOUT THE IRG.

2 - A MINIMUM OF 600µS OF TRANSITION FREE IRG MUST PRECEDE EACH PREAMBLE. (THIS REQUIREMENT IS USUALLY SATISFIED BY THE START DELAY PRIOR TO WRITE.)

3 - VALUE SUPPLIED BY TRANSPORT IS APPROX 70MS. AS AN ALTERNATE THE CUSTOMER CAN SUPPLY AN EXTERNAL DELAY WHICH IS EITHER LESS OR GREATER THAN 70MS DEPENDING ON THE CASSETTE AND SPECIFIC APPLICATION.

4 - CAUTION: CARE SHOULD ALWAYS BE TAKEN TO ASSURE THAT ALL EXTRANEOUS DATA IS REMOVED FROM AN IRG.

RECOMMENDED WRITE SEQUENCE BRAEMAR CS-400A ALL SPECIFICATIONS AT 10 IPS; 800 BPI	SPEC 0050 PAGE 3



2 - FOR PROPER DECODING A MINIMUM OF 600 µS OF IRG FREE OF ANY TRANSITIONS MUST PRECEDE EACH PREAMBLE. THIS REQUIREMENT IS USUALLY SATISFIED BY THE "WRITE DATA START DELAY," (PIN H). SEE WRITE SEQUENCE.

1 - SEQUENCE SHOWN ASSUMES THAT SYSTEM IS STOPPED AND IS IN WRITE FOLLOWING THE READ PERIOD. IF THE USER IS READING SEVERAL RECORDS SEQUENTIALLY WITHOUT STOPPING, THE SYSTEM SHOULD BE LEFT IN READ THROUGHOUT THE IRG'S.

NOTE:

RECOMMENDED READ SEQUENCE BRAEMAR CS-400A ALL SPECIFICATIONS AT 10 IPS, 800 BPI	SPEC 0050 PAGE 4

NOTES

NOTES

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